

UNCLASSIFIED

AD 295 546

*Reproduced
by the*

ARMED SERVICES TECHNICAL INFORMATION AGENCY
ARLINGTON HALL STATION
ARLINGTON 12, VIRGINIA



UNCLASSIFIED

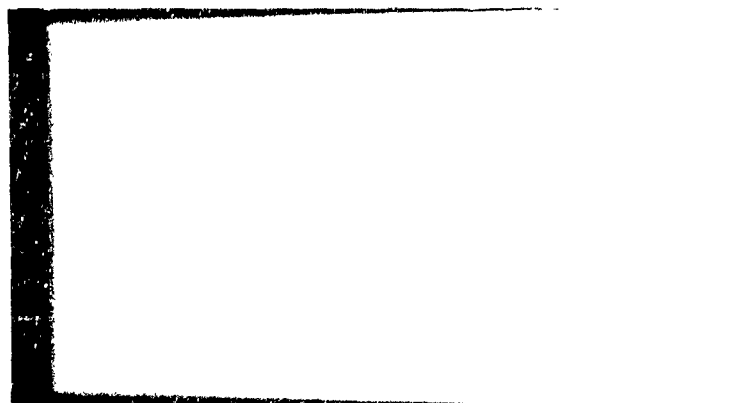
NOTICE: When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U. S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

Classified by *ATL TIPA*

295 546

295 546

CATALOGED BY ASTIA
AS AD NO. _____



ASTIA
RECEIVED
FEB 6 1963
REGISTERED
TISIA

MCDONNELL

NO OTS

DATE 10 January 1963

REVISED _____

ELECTRICAL POTTING COMPOUNDS -

ADHESION TO TEFLON WIRE

AT ELEVATED TEMPERATURES

REPORT 9355 SERIAL NO. 12

MCDONNELL AIRCRAFT CORPORATION

This report was prepared under Contract Number AF 33(657)-7749 and BPSN: 2(8-7381)-73812. Additional information pertaining to any data contained herein may be obtained from the Directorate of Materials and Processes (ASRCEM-1), Aeronautical Systems Division, Air Force Systems Command, United States Air Force, Wright-Patterson Air Force Base, Ohio, or McDonnell Aircraft Corporation, St. Louis, Missouri

INDEX

CODE (Plstc-8, 20 Enc)(V-1)

DATE 6 March 1962

REVISED _____

REVISED _____

McDONNELL *Aircraft Corporation*

ST. LOUIS, MISSOURI

LABORATORY REPORT

PAGE 1
REPORT 9355SYSTEMS LABORATORYFINAL REPORTElectrical Potting Compounds - Adhesion to Teflon Wire
at Elevated Temperatures

ABSTRACT

Potted electrical connectors are currently being used at M.A.C. to waterproof MIL-W-16878 Type E Teflon hook-up wire. In order for the hook-up wire to be completely waterproof, the potting compound must adhere to the wires through the temperature range encountered. This test was initiated to compare the adhesion properties of two different silicone potting compounds and two different primers.

RTU-60 and EC-1663 potting compounds and their catalysts, together with EX-B-579-1 and EC-1694 primers were tested under conditions simulating wire bundle installation and removal handling. These tests were conducted before, during, and after a 24 hour soak at 500°F.

The major mode of failure was the loss of adhesion of the primer to the Tetra-Etched Teflon hook-up wire.

The EX-B-579-1 primer was superior to the EC-1694 primer. The RTU-60 potting compound appeared to have better adhesion properties than the EC-1663 potting compound.

Tests conducted at 500°F resulted in a considerable loss of adhesion in all cases.

PREPARED BY

Russ H. Pfeiffer
Test Engineer

APPROVED BY

Edmund W. Higgins
Senior Engineer, Materials and Methods
(Chemical Group)

APPROVED BY

James L. Palmer
Chief, Systems Laboratory

APPROVED BY

John L. Taper
Laboratory Project Engineer

DISTRIBUTION: C. Fleming, A. Haffner, R. F. Johnson, Eng. Library
(abstracts) E. C. McCandlish, C. Fuqua, E. Pieper

DATE 6 March 1962

REVISED _____

REVISED _____

McDONNELL *Aircraft Corporation*

ST. LOUIS, MISSOURI

LABORATORY REPORT

PAGE 2

REPORT 9355

1. OBJECTIVE

FINAL REPORT

To determine the adhesion characteristics of silicone RTV potting compounds relative to MIL-W-16878 Type E Etched Teflon hook-up wire.

2. PROCEDURE

2.1 Test Specimen Preparation

The specimens were prepared as shown in Figure 1, Page 4, and in the quantities shown in Table 1, Page 5, of this report.

The ends of the wires that were embedded in the potting compound were Tetra-Etched in accordance with M.A.C. P.S. 17165 (dated 23 August 1960) and as modified by Amendment No. 1, dated 31 March 1961).

The potting compound was primed, mixed, applied, and cured as shown in P.S. 17172, Rev. B, dated 9 May 1960, except in the cases where the Hugheson Primer was used. In these cases the priming instructions of P.S. 17311, dated 16 November 1960, were followed.

3. TESTING PROCEDURE

Two samples of each type of specimen were tested at each temperature condition described below. ("Type" of specimen includes catalyst variations of GE RTV-60).

- (a) Room temperature
- (b) After 24 hours at 500°F (while still hot)
- (c) Upon cooling to room temperature

The potting-wire adhesion was checked as follows:

While maintaining sufficient tension on the wire to remove all slack, the wire was rotated and oscillated to strain the potting-wire junction and thereby simulate the strains a potted electrical connector endures during wire bundle installation and removal handling. The wire was then tugged sufficiently to fail the potting-wire junction and the relative ease with which failure was obtained and the type of failure (adhesive, cohesive, or both) was noted.

4. TEST RESULTS

The test results are presented in Table 2, Page 6, of this report.

DATE 6 March 1962

REVISED _____

REVISED _____

McDONNELL *Aircraft Corporation*

ST. LOUIS, MISSOURI

LABORATORY REPORT

PAGE 3

REPORT 9355

5. DISCUSSION OF RESULTS

FINAL REPORT

There appeared to be little difference in specimen preparation or in test results where varied catalysts were used with the RTV-60, though the RTV-9930 catalyst cured the potting compound more rapidly than any of the other RTV catalysts. This catalyst yielded a RTV-60 mix with one hour pot life.

The Teflon wire used in specimens 25 through 32 was a white wire which differed from the wire used in the remaining specimens (a clear coated wire). The white wire, manufactured by the Thermal Wire Co. of America, appeared to give better results than the wire used on the other samples. Both wires were MIL-W-16878 Type E.

Nearly all potting-wire junctions failed relatively easily while tested at condition "b" (while still hot). The failures were nearly all adhesive and appeared to be caused by the failure of the primer to adhere to the Teflon wire.

The EC-1694 primer nearly always failed adhesively upon rotation of the wire, even if very little tension was used.

6. CONCLUSION

The major mode of failure was the loss of adhesion of the primer to the Teflon hook-up wire.

The Hughsen EX-B579-1 primer was superior to the EC-1694 of the 3M Co.

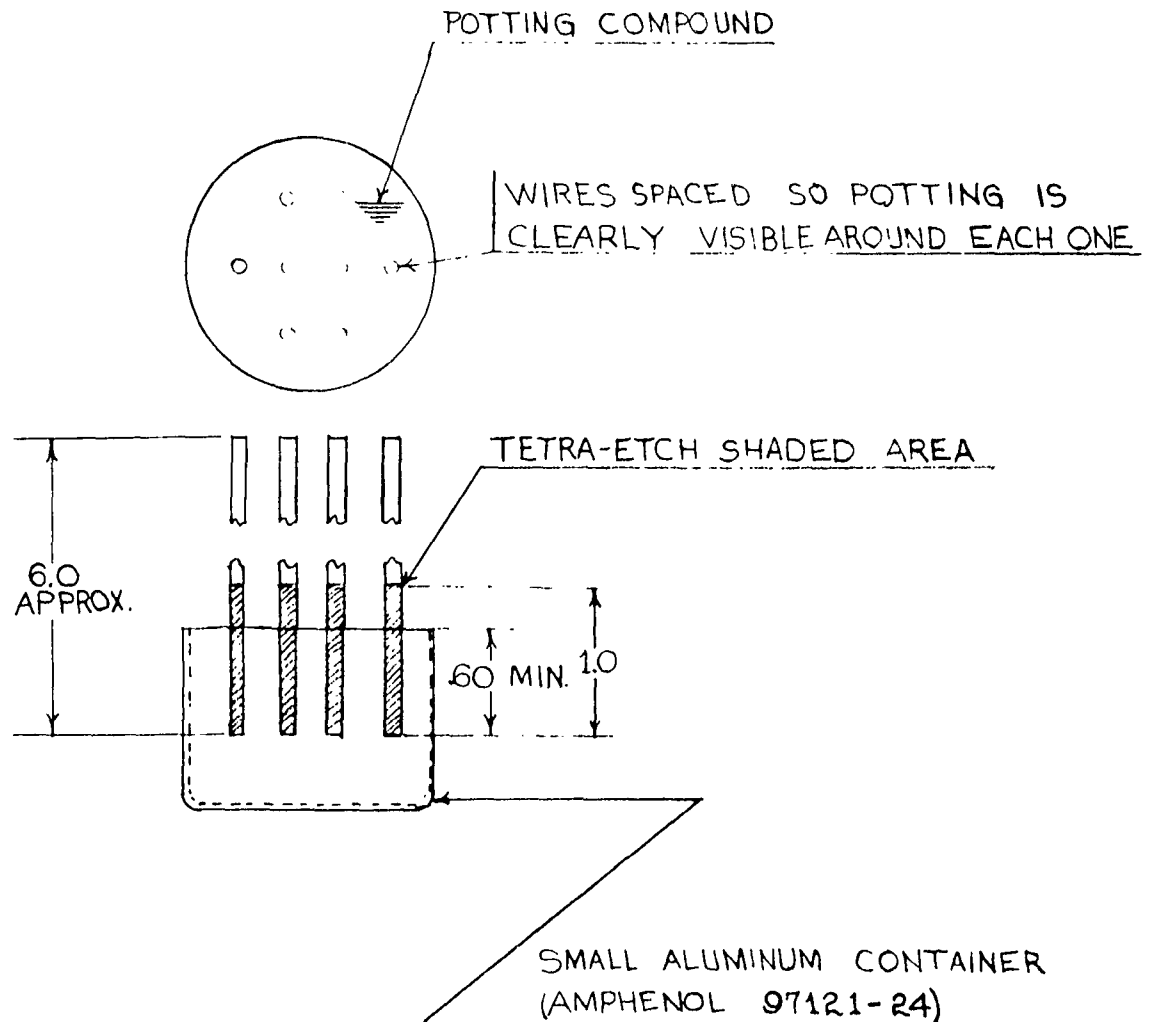
The best results were obtained using GE RTV-60 potting compound and the RTV-9930 catalyst with the Hughsen EX-B579-1 primer.

DATE _____
REVISED _____
REVISED _____

LABORATORY REPORT

FINAL REPORT

FIGURE 1



DATE _____

REVISED _____

REVISED _____

LABORATORY REPORT

FINAL REPORT

TABLE 1

SPECIMEN NUMBER	POTTING COMPOUND	CATALYST	CATALYST WEIGHT PER CENT	PRIMER
1 THRU 6	RTV-60	T-12	0.1%	HUGHSON
7 THRU 12	RTV-60	T-12	0.1%	EC-1694
13 THRU 18	RTV-60	RTV-9910	10%	HUGHSON
19 THRU 24	RTV-60	RTV-9910	10%	EC-1694
25 THRU 30	RTV-60	RTV-9930	10%	HUGHSON
31 THRU 36	RTV-60	RTV-9930	10%	EC-1694
37 THRU 42	EC-1663	3M CO.	10%	HUGHSON
43 THRU 48	EC-1663	3M CO.	10%	EC-1694

DATE _____

REVISED _____

REVISED _____

LABORATORY REPORT

FINAL REPORT

TABLE 2

		COHESIVE	NONE	DIFFICULT	
1	(a)	COHESIVE	NONE	DIFFICULT	
2	(a)	COHESIVE	NONE	DIFFICULT	
3	(b)	ADHESIVE	EASY	EASY	LOSS OF PRIMER ADHESION
4	(b)	ADHESIVE	EASY	EASY	LOSS OF PRIMER ADHESION
5	(c)	80% CO; 20% AD.	MODERATE	DIFFICULT	SLIGHT LOSS OF PRIMER ADHESION
6	(c)	80% CO; 20% AD.	MODERATE	DIFFICULT	SLIGHT LOSS OF PRIMER ADHESION
7	(a)	10% CO; 90% AD.	EASY	MODERATE	LOSS OF PRIMER ADHESION
8	(a)	10% CO; 90% AD.	EASY	MODERATE	LOSS OF PRIMER ADHESION
9	(b)	ADHESIVE	EASY	EASY	LOSS OF PRIMER ADHESION
10	(b)	ADHESIVE	EASY	EASY	LOSS OF PRIMER ADHESION
11	(c)	10% CO; 90% AD.	EASY	EASY	LOSS OF PRIMER ADHESION
12	(c)	10% CO; 90% AD.	EASY	EASY	LOSS OF PRIMER ADHESION
					OBSERVATIONS
					RELATIVE EASE OF TUGGING FAILURE
					RELATIVE EASE OF ROTATIONAL FAILURE
					TYPE OF FAILURE
					CONDITIONS RT TEST
					SPECIMEN NUMBER

DATE _____

REVISED _____

REVISED _____

LABORATORY REPORT

FINAL REPORT

TABLE 2 CONTINUED

		COHESIVE	NONE	DIFFICULT	LOSS OF PRIMER ADHESION
13	(a)	COHESIVE	NONE	DIFFICULT	
14	(a)	COHESIVE	NONE	DIFFICULT	
15	(b)	ADHESIVE	MODERATE	MODERATE	
16	(b)	ADHESIVE	MODERATE	MODERATE	
17	(c)	COHESIVE	DIFFICULT	DIFFICULT	
18	(c)	COHESIVE	DIFFICULT	DIFFICULT	
19	(a)	10% CO.; 90% AD.	EASY	MODERATE	LOSS OF PRIMER ADHESION
20	(a)	10% CO.; 90% AD.	EASY	MODERATE	LOSS OF PRIMER ADHESION
21	(b)	ADHESIVE	EASY	EASY	LOSS OF PRIMER ADHESION
22	(b)	ADHESIVE	EASY	EASY	LOSS OF PRIMER ADHESION
23	(c)	10% CO.; 90% AD.	EASY	EASY	LOSS OF PRIMER ADHESION
24	(c)	10% CO.; 90% AD.	EASY	EASY	LOSS OF PRIMER ADHESION
					OBSERVATIONS
					RELATIVE EASE OF TUGGING FAILURE
					RELATIVE EASE OF ROTATIONAL FAILURE
					TYPE OF FAILURE
					CONDITIONS AT TEST
					SPECIMEN NUMBER

DATE _____

REVISED _____

REVISED _____

LABORATORY REPORT

FINAL REPORT

TABLE 2 CONTINUED

		COHESIVE	NONE	DIFFICULT	
25	(a)	COHESIVE	NONE	DIFFICULT	
26	(a)	COHESIVE	NONE	DIFFICULT	
27	(b)	50% CO.; 50% AD.	DIFFICULT	DIFFICULT	
28	(b)	50% CO.; 50% AD.	DIFFICULT	DIFFICULT	
29	(c)	COHESIVE	DIFFICULT	DIFFICULT	
30	(c)	COHESIVE	DIFFICULT	DIFFICULT	
31	(a)	20% CO.; 80% AD.	EASY	EASY	LOSS OF PRIMER ADHESION
32	(a)	20% CO.; 80% AD.	EASY	EASY	LOSS OF PRIMER ADHESION
33	(b)	ADHESIVE	EASY	EASY	LOSS OF PRIMER ADHESION
34	(b)	ADHESIVE	EASY	EASY	LOSS OF PRIMER ADHESION
35	(a)	10% CO.; 90% AD.	EASY	MODERATE	LOSS OF PRIMER ADHESION
36	(a)	10% CO.; 90% AD.	EASY	MODERATE	LOSS OF PRIMER ADHESION
					OBSERVATIONS
					RELATIVE EASE OF TUGGING FAILURE
					RELATIVE EASE OF ROTATIONAL FAILURE
					TYPE OF FAILURE
					CONDITIONS AT TEST
					SPECIMEN NUMBER

DATE

REVISED

REVISED

LABORATORY REPORT

FINAL REPORT

TABLE 2 CONTINUED

		COHESIVE	NONE	DIFFICULT	
37 (a)		COHESIVE	NONE	DIFFICULT	
38 (a)		COHESIVE	NONE	DIFFICULT	
39 (b)		10% CO; 90% AD	EASY	EASY	LOSS OF PRIMER ADHESION
40 (b)		10% CO; 90% AD	EASY	EASY	LOSS OF PRIMER ADHESION
41 (c)		70% CO; 30% AD	MODERATE	MODERATE	SLIGHT LOSS OF PRIMER ADHESION
42 (c)		70% CO; 30% AD	MODERATE	MODERATE	SLIGHT LOSS OF PRIMER ADHESION
43 (a)		50% CO; 50% AD	NONE	MODERATE	SLIGHT LOSS OF PRIMER ADHESION
44 (a)		10% CO; 90% AD	MODERATE	MODERATE	SLIGHT LOSS OF PRIMER ADHESION
45 (b)		ADHESIVE	EASY	EASY	LOSS OF PRIMER ADHESION
46 (b)		ADHESIVE	EASY	EASY	LOSS OF PRIMER ADHESION
47 (c)		50% CO; 50% AD	DIFFICULT	MODERATE	LOSS OF PRIMER ADHESION
48 (c)		50% CO; 50% AD	DIFFICULT	MODERATE	LOSS OF PRIMER ADHESION
					OBSERVATIONS
					RELATIVE EASE OF TUGGING FAILURE
					RELATIVE EASE OF ROTATIONAL FAILURE
					TYPE OF FAILURE
					CONDITIONS AT TEST
					SPECIMEN NUMBER

TEST REQUEST

PAGE 10
REPORT 9355TITLE ELECTRICAL POTTING COMPOUNDS - SURFACE AND VOLUMERESISTIVITY AT ELEVATED TEMPERATURES FOR PROTRACTED TIMES

LABORATORY OR DEPT. RESPONSIBLE FOR TEST <u>D252</u> <u>(X) test</u>	MODEL Misc.
TEST PARTS ON IBM <input type="checkbox"/> : ON TPL NO. _____	APL/EPI
PRODUCTION PARTS FOR TEST NOT REQUIRED <input checked="" type="checkbox"/>	None

WORK REQUESTED

OBJECTIVE (GIVE PURPOSE OF TEST, WORK AND DATA REQUIRED INCLUDING SERVICE HISTORY AND BACKGROUND INFORMATION)
 Rev. "A" Revised pages 1, 2 and 3 to cancel all tests concerning the Gore wire and also to check a new
1.0 OBJECT: catalyst for RTV-60. *reduced accordingly KR mills 26 Dec*
 To determine the adhesion characteristics of silicone RTV potting compounds relative to MIL-W-16878 Type E Teflon hook-up wire. and ~~W. L. Gore Type AR Teflon hook-up wire.~~

2.0 HISTORY:

(A)
 At present the Teflon hook-up wire being used for various electrical and electronic purposes is designated as MAC Standard 5M14 Type E. This wire is basically MIL-W-16878 Type E. In another test (TR. 604-001.02) a new mineral-filled Teflon hook-up wire (W. L. Gore Type AR) is being evaluated to determine whether it has properties that would recommend its use instead of the MIL-Spec. wire for certain applications.

(TR. 604-001.02 showed the Gore wire not worthy of
3.0 JUSTIFICATION: further consideration)

To achieve true waterproofing of potted electrical connectors the potting must adhere to the wires. This adhesion must be continuous throughout the temperature range encountered.

4.0 MATERIALS:

- 4.1 G.E. RTV-60 Potting Compound and Catalysts Thermolite-12, ~~and RTV-991 (Supplied by Dept. 272).~~ RTV-9910, and RTV-9930
- 4.2 3M Co. EC-1663 Potting Compound (from MAC Stock).
- 4.3 Hughson Chemical Co. EX-B579-1 Primer (from MAC Stock).
- 4.4 3M Co. EC-1694 Primer (from MAC Stock).

REFERENCES OR ENCLOSURES

via Pak to

4.0 MATERIALS: (Continued)

4.5 20 gage Teflon Hook-up Wire (5M114E20Z9, from MAC Stock).

~~4.6 20 gage W. L. 80 Type AN Teflon Hook-up Wire (201932 ENR, Supplied by Depo 870).~~

5.0 TEST SPECIMEN PREPARATION:

5.1 The test specimens are to be made as shown in Figure 1 and in the quantities shown in Table I.

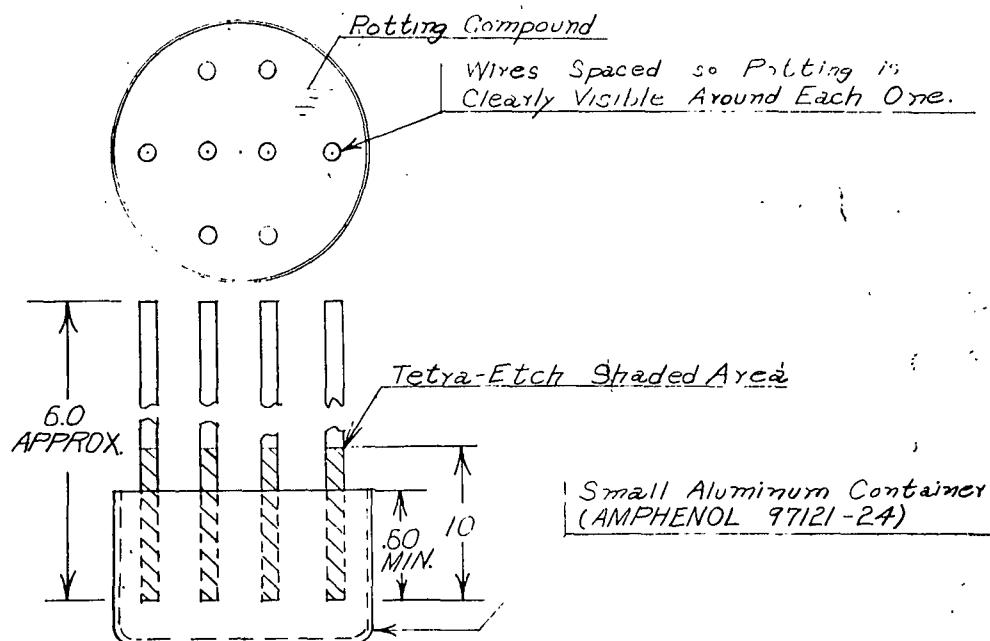


FIGURE 1 - TEST SPECIMEN

- 5.2 The ends of the wires that will be embedded in the potting compound shall be Tetra-Etched in accordance with MAC P.S. 17165 (dated 23 August 1960 and as modified by Amendment No. 1 dated 31 March 1961).
- 5.3 When priming is done with Hughson Primer, follow the PRIMING instructions of P.S. 17311, dated 16 November 1960.
- 5.4 When priming is done with the 3M Co. Primer, follow the PRIMING instructions of P.S. 17172, Rev. B, dated 9 May 1960.
- 5.5 Clean the wires after Tetra-Etching and before priming as shown in P.S. 17172 (NOT as shown in P.S. 17311).
- 5.6 Mix, apply, and cure the potting compound in accordance with P.S. 17172.

5.0 TEST SPECIMEN PREPARATION: (Continued)

5.7 As shown in Table I, use 0.1% by weight of Thermolite-12, 10% by weight of RTV-9910, or 10% by weight of RTV-9930 as the catalyst for the G.E. RTV-60.

Specimen No.	Potting Compound	Catalyst	Primer
1 thru 6	RTV-60	T-12	Hughson
7 thru 12	RTV-60	T-12	EC-1694
13 thru 18	RTV-60	RTV-9910	Hughson
19 thru 24	RTV-60	RTV-9910	EC-1694
25 thru 30	RTV-60	RTV-9930	Hughson
31 thru 36	RTV-60	RTV-9930	EC-1694
37 thru 42	EC-1663	3M Co.	Hughson
43 thru 48	EC-1663	3M co.	EC-1694

6.0 TESTING PROCEDURE:

6.1 Check adhesion of the potting compound to the wires on 2 samples of each type of specimen at each temperature condition described below:

- (a) Room temperature
- (b) After 24 hours at 500°F (while still hot).
- (c) Upon cooling to room temperature.

NOTES: (1) "Type" of specimen includes catalyst variations of G.E. RTV-60.

- (2) Four specimens of a given type are to be placed in a circulating air oven maintained at 500°F for 24 hours.

At the end of this time remove two of the specimens from the oven and allow them to cool completely to room temperature before testing for adhesion. Test the remaining two specimens while in the oven if possible or else immediately upon their removal from the oven before any appreciable cooling occurs.

6.0 TESTING PROCEDURE: (Continued)

6.1.1 Check potting-wire adhesion as follows:

While maintaining sufficient tension on the wire to remove all slack, rotate and oscillate the wire to strain the potting-wire junction and thereby simulate the strains a potted electrical connector endures during wire bundle installation and removal handling. Tug sufficiently during the rotation and oscillation to fail the potting-wire junction and note whether the failure is adhesive, cohesive, or a combination of the two.

6.2 A representative of Department 272 to be present during these tests.

7.0 DATA REQUIRED:

7.1 For each specimen note the type of failure (see paragraph 6.1.1) and the relative ease with which failure was obtained.

7.2 Black and white photographs of failure areas.

8.0 SPECIMEN DISPOSITION:

8.1 At the conclusion of the tests return all specimens to Department 272.